What is Claimed is:

1. A process for curing a natural or synthetic rubber with fillers using a variety of vulcanization equipment, comprising:

a) measuring curing conditions by dielectric or impedance means applied on opposite sides and through the rubber part or a witness cavity representing the part during the curing process to produce a process curve for a specific rubber compound which is correlated with the rheometric properties of the rubber compound and the desired or specified mechanical properties of the rubber part;

b) analyzing the process curve for the specific rubber compound with a software algorithm which defines and quantifies the correlation relationship between the process curve and the rheometric properties of the rubber compound and the desired part mechanical properties;

c) applying the correlation relationship in real-time to end the curing process and produce rubber part(s) of uniform quality and with reduced process cycle time.

2. The process of Claim 1, in which the dielectric or impedance measurement circuit is non-bridged.

3. The process of Claim 1, in which the correlation is accomplished using a defined range of cure conditions or statistically designed experiment.

4. The process of Claim 1, in which the correlation is accomplished using an impedance sensor installed in ODR, MDR, or similar rheometric instrument.

5. The process of Claim 1, in which the said software algorithm identifies and uses a Maximum Value, and/or Time of Maximum Value in a specific time segment of the process curve to calculate the end of cure time.

6. The process of Claim 1, in which the said software algorithm identifies and uses a Minimum Value, and/or Time of Minimum Value in a specific time segment of the process curve to calculate the end of cure time.

7. The process of Claim 1, in which the said algorithm uses the rate of a cure as measured by a linear least-squares best fit over a specified time segment of the process curve and the slope of the segment measured is defined as m in the equation:

$$y = mx + b.$$

8. The process of Claim 1, in which the said algorithm uses the rate of a cure as measured by an exponential best fit over a specified time segment of the process curve and the damping coefficient of the segment measured is defined as α in the equation:

$$y = Ae^{-\alpha}$$

9. The process of Claim 1, in which the said algorithm uses the rate of a cure as measured by an exponential best fit over a specified time segment of the process curve and the amplitude coefficient of the segment measured is defined as A in the equation:

$$y = Ae^{-\alpha x}$$

10. The process of Claim 1, in which the said algorithm uses the integrated area under the process curve or a portion of the curve to calculate the end of cure time.

11. The process of Claim 1, in which the dielectric or impedance measurements include impedance (Z), phase angle (Φ), resistance (R), reactance (X), conductance (G) and capacitance (C) as values for the y-axis of the process curve as plotted against time on the x-axis.

12. The process of Claim 1, in which the correlation is made between mathematical measurements of the process curve and rheometric property measurements of the rubber compound and to the desired or specified part mechanical properties such as tensile strength, compression set, dynamic stiffness, or elastic torque.

13. The process of Claim 12, in which the final correlation to the part mechanical properties is made with a modifier which provides a linear adjustment to the T90, T75, T50, T2 or rheometric correlation equation.

14. The process of Claim 1, in which the impedance measurements are made at a frequency of about 10Hz to 200,000Hz.

15. The process of Claim 1, in which said natural and synthetic rubber compounds are typically selected from the group consisting of: styrene-butadiene, polybutadiene,

polyisoprene, ethylene-propylene, butyl, halobutyl, ntirile, polyacrylic, neoprene, hypalon, silicone, fluorcarbon elastomers, polyurethane elastomers, and mixtures thereof.

16. The process of Claim 15, in which rubber compound fillers consist of: carbon black, clays, oils, silicas, and the like.

17. The process of Claim 1, in which the said process is controlled by means of a computer.

18. The process of Claim 17, in which said computer controls the process by receiving a "start cure" signal from the vulcanization equipment and based on a predefined software algorithm sends an "end cure" signal back to the vulcanization equipment.

19. The process of Claim 1, in which the rubber part is processed using vulcanization equipment and its associated tooling and the impedance measuring means includes the vulcanization equipment and/or its associated tooling.

20. The process of Claim 19, in which the impedance measuring means includes a primary sensor electrode coupled with an opposing grounded surface electrode, which is part of the vulcanization equipment or associated tooling.

21. The process of Claim 19, in which the impedance sensor is located either in contact with the part or in contact with a rubber filled witness cavity that is representative of the part.

22. The process of Claim 19, in which the impedance sensor includes an additional guard electrode to help preclude the primary electrode from fringing or becoming non-linear.

23. The process of Claim 19, in which the impedance sensor primary and guard electrodes are separated from the rubber compound being processed by alumina ceramic or other stable and abrasion resistant dielectric material.

24. The process of Claim 19, in which the impedance sensor primary electrode, guard electrode, and housing are separated electrically from each other by a dielectrically stable polymer such as cyanate ester and alumina ceramic.

25. The process of Claim 19, in which the impedance sensor primary electrode, guard electrode, and housing are fused together and separated electrically from each other by glass or glass doped with alumina ceramic or other like material.

26. The process of Claim 19, in which the primary electrode and guard electrode are embedded in a metallized and layered ceramic circuit.

27. The process of Claim 19, in which the primary electrode, guard electrode, and housing are press fit together and separated electrically from each other and the rubber compound being cured by a diamond or diamond like coating.

28. The process of Claim 18, in which said vulcanizing equipment includes: injection molding machines, compression and transfer molding presses, belt making presses, autoclaves, tire molding machines, and the like.

29. The process of Claim 19, in which said tooling includes: injection molds, compression and transfer molds, mandrels, platens, tire molds, and the like.

30. The process of Claim 18, in which said control is accomplished using more than one sensor to monitor the process, and the lagging sensor from cycle-to-cycle is used to control the end point of any given cure cycle.